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ABSTRACT

This document summarizes the results of two surveys about the current administrative uses of computers in higher education. Included in the document is: (1) a brief history of the development of computer operational and management information systems in higher education; (2) information on how computers are currently being used to support administration at the operational and management levels; (3) estimates of the allocation of computer resources by institutional size and type and by application area; (4) identification of factors related to the development of computer-based management information systems, including organizational considerations. The primary purpose of this document is to provide higher education administrators with a general picture of current trends so that they may compare their efforts and plans with these trends. Chapters include: (1) use of computers in college and university administration, (2) development of computer-based management information systems, and (3) organizational considerations. Tables provide statistical information. (Author/KF)

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AN OVERVIEW OF TWO RECENT SURVEYS OF ADMINISTRATIVE COMPUTER OPERATIONS IN HIGHER EDUCATION

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The Program of the National Center for Higher Education Management Systems at WICHE was proposed by state coordinating agencies and colleges and universities in the West to be under the aegis of the Western Interstate Commission for Higher Education. The National Center for Higher Education Management Systems at WICHE proposes in summary:

To design, develop, and encourage the implementation of management information systems and data bases including common data elements in institutions and agencies of higher education that will:

- provide improved information to higher education administration at all levels.
- facilitate exchange of comparable data among institutions.
- facilitate reporting of comparable information at the state and national levels.

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PREFACE

ADMINISTRATIVE COMPUTING OPERATIONS IN HIGHER EDUCATION

Past surveys of computers in higher education have focused on inventories of equipment and academic programs,[1] to the exclusion of administrative uses. While these inventories of computer hardware provide important comparative and historical information, the assessment of development of administrative applications is also important. The latest survey of administrative use of computers in higher education was published in 1970 by the American Association of Collegiate Registrars and Admissions Officers.[2] This survey was restricted to administrative uses for admissions, student records, and registration.

Two recent surveys, one conducted by the National Center for Higher Education Management Systems (herein referred to as the NCHEMS Survey) and one conducted by Dr. Richard L. Mann, Director of Management Information Systems at the University of Illinois at Urbana-Champaign (herein called the CBMIS Survey), provide a good deal of data about the current administrative uses of computers in higher education.

This document summarizes the results of these surveys. Included in the document are:

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[1] John W. Hamblen, Inventory of Computers in U. S. Higher Education (Washington, D.C.: National Science Foundation, 1969-1970).

[2] American Association of Collegiate Registrars and Admissions Officers, Survey of the Management and Utilization of Electronics Data Processing Systems in Admission, Records and Registration (Washington, D.C.: 1969-1970).

- A brief history of the development of computer-based operational and management information systems in higher education.

- Information on how computers are currently being used to support administration at the operational and management levels.

- Estimates of the allocation of computer resources by institutional size and type and by application area.

- Identification of factors related to the development of computer-based management information systems, including organizational considerations.

The primary purpose of this document is to provide higher education administrators with a general picture of current trends so that they may compare their efforts and plans with these trends.

As pointed out in the document, the NCHEMS Survey included information from only forty-eight institutions; however, definite trends in the use of computers for administrative operations are evident and are outlined. The CBMIS Survey included over 400 institutions, and information from that survey is representative of the trends in computer-based management information systems development in higher education.

The authors of this document wish to thank the institutions that willingly supplied much detailed information on the surveys and hope that they and others will benefit from the publication. In addition, acknowledgment is also due to Ms. Marilynn Hajek, who coordinated the NCHEMS Survey.

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I. INTRODUCTION

History

A number of colleges and universities began to automate clerical and bookkeeping functions in the late 1940s. In most instances these early "tab shops" emerged in one of two administrative areas--the Business Office or the Registrar's Office. It often is possible to trace current organizational relationships (such as administrative data processing reporting to the vice-president for financial affairs) and the degree to which various applications are developed (such as more emphasis on the student data area than other applications) from these historical roots.

The "tab shops" of the 1950s were equipped with mechanical card sorters, calculating card punches, reproducing punches, mechanical collaters, and tabulators that added, subtracted, and printed reports at rates of 150 lines per minute. The past two decades have seen the development of three generations of computing equipment, and information-handling capabilities have multiplied by orders of magnitude since the early 1950s.

During the 1950s colleges and universities began to acquire their first commercial computers. This first generation of computers was devoted primarily to research applications for mathematical and scientific efforts. Gradually computers began to supplant the "tab shop" as a way of speeding up manual and clerical operations. The techniques of this early era were dominated by the fact that administrative applications were being run on research-oriented computer systems.

The second-generation computers, featuring magnetic tape storage and high-speed line printers, became available in the early 1960s and provided a natural replacement for the "tab" installations. During this period there was an increasing use of magnetic media to replace punched cards, but the general design of administrative systems changed little from the tabulating approach. Matching sequential files and batch-processing techniques were the mainstay of administrative applications.

It is largely acknowleged that third-generation hardware became available in 1964 with the announcement of the IBM System 360. The majority of institutions began using third-generation hardware during 1967-68 and are still using this hardware. Third-generation computers featured direct access storage, sophisticated operating systems, time sharing, and use of remote terminals (on-line facilities). The administrative computer installations began to utilize this more powerful computer technology in administrative systems. Generally the first step in the use of remote terminals was to load sequential files at a central facility and make the information available through terminals for inquiry and display only. The next step involved the use of on-line technology to gather data for batch-process file maintenance. Only recently have some colleges and universities started to use on-line file maintenance techniques in administrative systems applications.

The number and the scope of tasks subjected to automation technology also have grown rapidly in the past twenty years. The registration and grade recording assistance provided by the tabulating shop from "packets of student cards" in the 1950s has, in the 1970s, evolved into elaborate student

information systems that provide on-line access to basic files, computational procedures and reports for admissions, registration, scheduling, drops and adds, class rosters, classroom utilization, grades, transcripts, housing, student aid, enrollment forecasting, and so forth.

Similarly, payroll applications of the 1950s have grown into full-blown personnel systems with biographical, job description, activity reporting, and appointment, budget, and historical data and reporting capabilities. More and more applications are seen as coming under the umbrella of the "system" and many potential users of automation are awaiting "their turn" at most institutions.

The operational data systems used for administration in colleges and universities generally have been developed one-by-one with little cognizance of the interrelationships among systems. In most institutions, the development staff spend a sizeable portion of their effort simply dealing with the backlog of departments needing administrative computer services. In addition, it is estimated that maintenance of existing systems typically requires a substantial portion of the total data processing effort--in some institutions over 50 percent of the resources are devoted to this activity. Recently a number of institutions have begun to examine the use of data base management systems for administrative applications. This new technique shows great promise for institutions in attempts to overcome the problems caused by changing systems requirements and increased demands for unscheduled reports from existing data systems. In addition, the use of the data base management system for developing administrative applications encourages an integrated approach to the systems development process.

But what kinds of resources have been involved in administrative computing? How are these resources distributed? What particular administrative applications have been developed? Why are colleges and universities moving toward Computer-Based Management Information Systems (CBMIS)? To what extent, and along what lines, have CBMIS developed? How will academic institutions be organized to make best use of CBMIS? And finally, what general problems and concerns may be anticipated in incorporating CBMIS into present administrative computing facilities?

While there can be no definitive answers to any of these questions, decision makers are being called upon to analyze the relative costs and benefits of sophisticated computing systems. How much should such systems cost? What benefits should be expected from administrative computing? How should the computing function be organized and administered? We feel that the data available from two recent surveys can at least provide benchmarks for decision making and further inquiry into these kinds of questions.

The Surveys

The information on which this publication is based was drawn from two separate surveys conducted in late 1973 and early 1974. The aim of the first of these, which we will call the NCHEMS Survey, was to analyze the historical costs and personnel allocations of administrative computing offices, typical administrative computer applications, and the kinds of hardware used, and to assess management problems and concerns associated with administrative computing. This NCHEMS Survey was conducted on a fairly small scale. The questionnaire was sent to 100 institutions; 48 of these institutions responded. Section II discusses the results of the NCHEMS Survey.

The second survey was conducted by Dr. Richard Mann, Director of Management Information Systems at the University of Illinois.[3] The purpose of his study was to determine the extent to which computer-based management information systems (CBMIS) have been developed and are being planned. This CBMIS Survey was based upon a survey questionnaire mailed to 722 institutions throughout the United States. Responses were received from 66 percent of these institutions. Sections III and IV describe the findings of Dr. Mann's CBMIS Survey.

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[3]Richard L. Mann, "A Study of the Development of Computer Based Management Information Systems in Institutions of Higher Education" (Ph.D. dissertation, University of Illinois at Urbana-Champaign, 1973).

II. USE OF COMPUTERS IN COLLEGE AND UNIVERSITY ADMINISTRATION

Respondents to the NCHEMS Survey

The NCHEMS questionnaire was distributed to a representative sample of public and private institutions. An effort was made to obtain a sample that would fall into the control, level, and size categories in roughly the same proportions as they do across the nation. The original sample of 100 was distributed: by control, 59% public and 41% private; by level, 32% two-year and 68% four-year; and by size as follows:

0 - 5,000 enrollment--34%
5 - 10,000 enrollment--23%
10 - 15,000 enrollment--24%
above 15,000 enrollment--19%.

There were a total of 48 respondents. Their distribution on the above categories is as follows:

Public	26	(54%)	2-year	13	(27%)	0- 5,000	14	(29%)
Private	22	(46%)	4-year	35	(73%)	5-10,000	12	(25%)
	48	(100%)		48	(100%)	10-15,000	13	(27%)
						above 15,000	9	(19%)
							48	(100%).

These percentages are not significantly different from those of the original sample (chi-square is less than 0.02 in all three cases). Since the above categories were the most significant for identification purposes in the drawing of the original sample, no further attempt was made to assess response bias.

How Has Administrative Computer Use Increased Over the Years?

The increase in computer usage over the years since 1958 is striking. The rate of growth of administrative computing, as measured by annual expenditures, exhibited an average yearly increase of 33.4 percent between 1963 and 1968.

The annual expenditure increase in public institutions was 60 percent during academic year 1966-67. Administrative data processing personnel (full-time equivalent) showed an average increase of 35.4 percent per year between 1965 and 1970 in private institutions, and 19.8 percent in public colleges and universities (see Figures 1 and 2).

What Resources Are Involved?

Based on our sample of 48 institutions, administrative computing accounts for an average of 2.3 percent of an institution's total operating budget with an overall range of from .1 to 5.7 percent. Two-year institutions in the sample show a tendency to allocate a somewhat higher percentage of their resources for administrative computing (an average of 3.2% of their operating budgets).

How Are Computers Now Being Used for Administrative Applications?

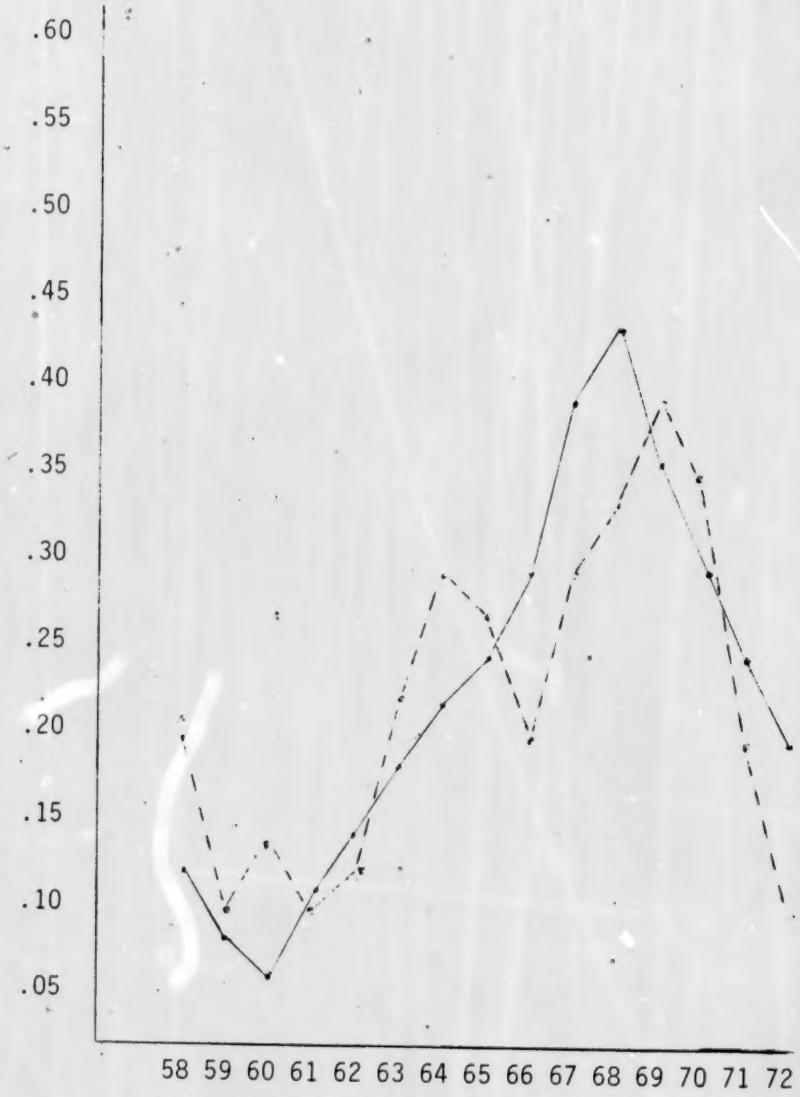
Twenty percent of the institutions still use the punch-card/tab approach for at least one application, and virtually all of the reporting institutions are using batch processing for some of their administrative applications.

Private institutions reported 26 percent of their applications were in an on-line mode, while public institutions showed an average of only 15 percent. The vast majority of applications were handled by batch-processing (76%).

How Are Administrative Data Processing Expenditures Distributed Across Hardware, Personnel, Software?

Across all institutions 34.5 percent of expenditures are applied to hardware; 15.1 percent are spent for software, supplies, and so forth;

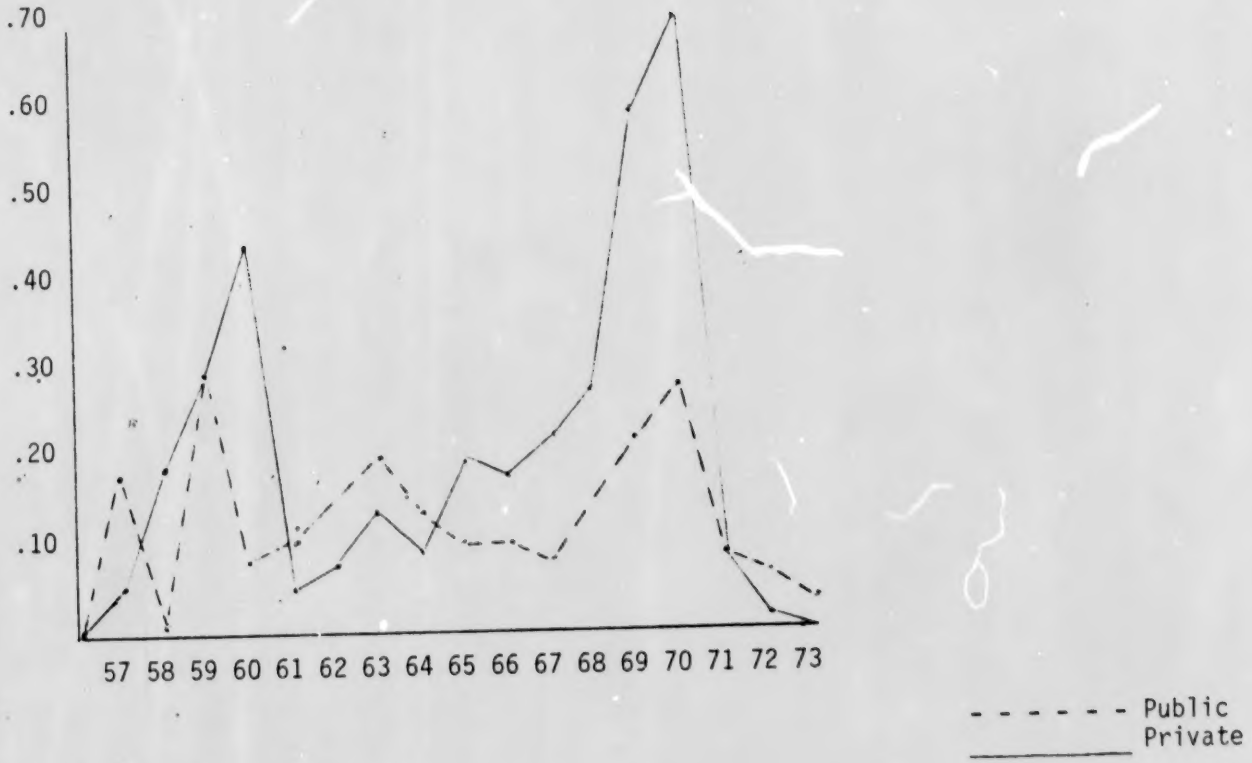
Figure 1: Percent Increase in Money Spent on Administrative Computing



———— Public
- - - - - - Private

(Smoothing: N=3, moving average)

Figure 2: Personnel Increases in Administrative Computing



and 50.4% are for personnel (see table below). Of the amount spent on personnel, management functions accounted for 19 percent of the cost and operations/production accounted for 45 percent of the cost, while development accounted for 36 percent (based on averages across all types of institutions, 2-year/4-year, public/private).

Eighty-one percent of the institutions surveyed used a single computer center for both administrative and academic (instruction and research) purposes, as opposed to a separate center for administrative computing. For those institutions with a "combined shop," an average of 57 percent of the resources were for academic use and 43 percent for administrative use.

To estimate the distribution of expenditures and full-time equivalent (FTE) personnel within the administrative computer offices, respondents were asked to provide actual costs and FTE in fiscal year 1972-73 for each of the following line items:

Personnel costs
Hardware costs
Other costs: software, supplies, and so forth

For the public and private and for different sizes of institutions, the following distributions of resources have been reported:

Table 1
Distribution of Expenditures
for Administrative Computer Offices (ACO)

Institution Type	Personnel % of Budget	Hardware % of ACO Budget	% Other (supplies software, etc.)	Administrative Computer Office % of Total Institutional Expenditures
Public	56.6	34.0	9.4	3.0
Private	49.5	32.9	17.6	1.4
<5,000	45.6	31.1	23.3	1.9
5-10,000	47.7	36.1	16.2	2.6
10-15,000	42.2	42.0	15.8	1.5
>15,000	57.5	28.4	14.1	3.6
All Institutions	51.4	33.5	15.1	2.3

What Applications Have Been Developed?

The survey attempted to assess the extent and scope of administrative computing. Nine broad administrative application areas were identified and respondents were asked to estimate the percentage of computer resources used for each application area.[4] As Table 2 indicates, the student and financial application areas represent over half the total complete resources expended on administrative data processing.

[4]For the purpose of this study, the term "computer resources" was defined as the total dollar expenditure for computer hardware applied to administrative data processing.

Table 2
Computer Resources by Control Type

	% Public	% Private	% Total
Student	41	31	37
Financial	20	27	23
Faculty/Staff	16	17	16
Alumni & Dev	5	12	8
Admin Acad Depts	6	3	5
Planning & Insti Res	4	4	4
Facilities	3	3	3
Logistical	3	2	2.5
Physical Plant	2	1	1.5
	100	100	100

Does the Size of the Institution Affect the Distribution of Percentages Among the Various Applications?

Grouping the institutions into the four size categories, the following distributions are obtained:

Table 3
Computer Resources by Size

	%<5,000	%5-10,000	%10-15,000	%>15,000
Student	27	45	39	34
Financial	25	21	21	25
Faculty/Staff	18	13	17	17
Alumni & Dev	13	5	9	7
Admin Acad Depts	5	6	3	6
Planning & Insti Res	2	5	4	3
Facilities	6	2	3	2
Logistical	2	2	2	4
Physical Plant	2	1	2	2
	100	100	100	100

What Major Problems in Administrative Computer Use Do Personnel Currently Identify?

Opinions were solicited from the president, academic vice-president, administrative/financial vice-president, and the administrative computing manager. The two major problems cited most often by these individuals were "key application areas not developed" and "lack of user involvement and capability in systems design." The administrative computing managers also saw "hiring and replacing personnel" and "application maintenance" as major problems; "support of top-level management" and "organizational problems" generally were rated as being of least concern in the responding institutions.

III. DEVELOPMENT OF COMPUTER-BASED MANAGEMENT INFORMATION SYSTEMS

Introduction

Pressures arising from the increasing growth and complexity of academic institutions, the severe financial constraints facing higher education, and the growing demands for accountability by governmental agencies are causing colleges and universities to turn increasingly toward management techniques aimed at more effective allocation of resources. A number of quantitative- and computer-based techniques such as program budgeting systems, institutional research, and simulation models increasingly are being used to support management decisions aimed at rational resource planning and allocation. To make effective use of these management science tools, academic institutions are giving increased attention to the development of computer-based management information systems (CBMIS) as a method of rapidly and accurately providing the diverse information needed to support these decision-making aids.

To date, most of the administrative uses of computer technology in academic institutions have been directed toward applications at the operations level. These applications have been oriented toward increasing the speed, accuracy, and general effectiveness of day-to-day clerical operations. Such operational applications represent the earliest attempts to apply computer technology to academic institutions. Today they comprise the great majority of administrative computer uses in colleges and universities, though they provide only minimal support for the kinds of management information needed by top-level administrators for institutional control, policy making, and planning.

The difficulty of gathering consistent, comprehensive, and accurate management information for institutional policy making and planning becomes apparent when one considers the great number of operational administrative data processing applications at the typical college or university. Each application that develops may be associated with only one department and may be designed to provide specific information in a unique way to its user. As each new application develops, new files, reports, and methods of acquiring information are developed, and duplication, inconsistency, and inconvenience become familiar problems to the university administrator seeking to collect interdepartmental information for policy making and planning purposes.

Unlike traditional administrative computer applications of an operational nature, a computer-based management information system is predicated on the notion that common information of various departments and agencies will be integrated and stored in a single computer file or data base, that the file is to be maintained centrally by and for the whole institution, and that whenever possible each unique data item will be entered and stored only once. The availability of institutional information in a systematically organized file or data base allows the administrator to select that information he requires, to organize it in any manner he chooses, to perform any required analyses upon it, and to obtain the required information rapidly and at a minimal cost.

In the context of this review, a computer-based management information system (CBMIS) is defined as a system used to store, manipulate, and retrieve

data for management planning and resource allocation purposes. The CBMIS is distinguished from standard data processing applications, such as payroll or student records, in that it emphasizes the capability to integrate and display data from various files, both current and historical, to assist administrators in planning, resource allocation, and general management decisions. A CBMIS is viewed as being composed of an integrated data base, commonly defined data elements, a generalized information retrieval capability, and those techniques required to assure the security and integrity of the data maintained in the data base.

Respondents to the CBMIS Survey

The CBMIS questionnaire was mailed to 722 institutions, from which 442 usable responses were received (66.2%). The study sample was composed of institutions with 3,000 or more students enrolled. Based on earlier research, it was anticipated that the preponderence of CBMIS activity would be found in institutions with 3,000 or more students enrolled.

In terms of institutional characteristics, responses were not significantly different from those of the sample (chi-square not greater than 0.05) when analyzed by institutional control (public, private), geographical location, or campus type (single campus, campus in a multicampus system, multicampus system office). Significantly higher responses, however, were received from institutions granting doctorate degrees, and from institutions with 10,000 or more students enrolled.

Why Are Colleges and Universities Moving Toward CBMIS?

Respondents to the CBMIS survey were asked to rank the most important reasons for their institution's beginning CBMIS development. "To improve internal management" stood out as the most important, with 229 institutions out of 293 ranking this reason first. The next most important reason specified was "support of other management tools," followed by "to meet state reporting requirements," which was ranked third by public institutions (see Table 4).

Aside from the general improvement of internal management, respondent institutions indicated that the support of other management tools was the primary reason for developing a CBMIS. This is borne out by the fact that, when Lawrence Bogard conducted his study of Management Information Systems (MIS) in colleges and universities in 1970, only 8 percent of the responding institutions with over 3,000 students reported having Planning, Programming, Budgeting Systems and institutional research in addition to CBMIS.[5] (In comparison, over 85% of the institutions planning or operating a CBMIS indicated in the Mann survey that they were using other management tools.) Indeed, the development of analytical techniques to assist management decision making appears to be a major factor in encouraging the development of a CBMIS (see Table 5).

[5]Lawrence Bogard, "Management in Institutions of Higher Education," Papers on Efficiency in the Management of Higher Education (Technical report sponsored by the Carnegie Commission on Higher Education, 1972).

Table 4
Reasons for Developing CBMIS

Reason	Ranking
To Improve Internal Management	1
To Support Other Management Tools	2
To Meet State Reporting Requirements	3*
To Meet Federal Reporting Requirements	4
To Make Better Use of Hardware and Software	5

*Ranked Last by Private Institutions

Table 5
Management Approaches Used by CBMIS Institutions*

Approach	%
Models	45
Planning, Programming, Budgeting Systems	41
Institutional Research	74

*85% of CBMIS Schools Use at Least One of These Management Approaches

To What Extent Are Colleges and Universities Developing CBMIS?

Of 430 institutions responding to the question, Is your institution planning or implementing a CBMIS? 69 percent replied affirmatively. Of the institutions, 40 percent reported their CBMIS in partial operation, 28 eight percent indicated they were still in the planning stage, and less than 1 percent of the schools stated that they had a fully operational CBMIS. Fewer than 14 percent of the institutions responding to the survey indicated that they did not intend to develop a CBMIS in the future or were undecided on development of a CBMIS.

Table 6
Status of CBMIS Development

	N	%
NO		
No Plans to Develop	31	7.2
Undecided	27	6.3
Intend to Develop a Plan	76	17.7
Total No	134	31.2
YES		
Presently Planning	121	28.1
In Partial Operation	172	40.0
In Full Operation	3	0.7
Total Yes	296	68.8

Although no statistically significant differences relating to CBMIS development were observed when the data were analyzed by various institutional characteristics, a number of interesting tendencies were noted:

multicampus institutions and public institutions reported CBMIS activity more frequently than did other institutions; schools with larger enrollments, especially over 20,000, showed a slightly greater percentage of CBMIS involvement; and it was observed that the higher the level of degree offered, the greater the percentage of institutions that were engaged in CBMIS development.

When the length of time CBMIS institutions have been planning and operating their systems was analyzed, the data showed that public institutions have been planning and implementing CBMIS somewhat longer than private schools. In addition, although multicampus institutions have been engaged in CBMIS planning significantly longer than single-campus schools, single-campus schools reported significantly more progress in terms of actually implementing CBMIS.

It was also observed that the larger an institution's enrollment, the longer that school was likely to have been engaged in both planning and implementing CBMIS, and that in both public and private institutions the greatest percentage of schools reported that they began their CBMIS planning and implementation activities between one and three years ago.

The survey results strongly suggest that a major effort to develop computer-based management information systems is underway in colleges and universities throughout the United States. Of those responding institutions with 3,000 or more students enrolled, nearly 70 percent have reported that they are actively planning or implementing a CBMIS. When the responses to the CBMIS

survey were compared with those reported by Lawrence Bogard in his 1970 study, a 13 percent increase (from 26 to 41%) in the number of institutions engaged in partial or full CBMIS operation was revealed.[6] Although comparative data were not available from Bogard, one may speculate that the number of institutions engaged in CBMIS planning has increased by an even greater percentage since the 1970 study.

The fact that CBMIS activity appears to be concentrated in public institutions, those with larger enrollments, those offering higher degrees, and in multicampus schools may be due to two factors. First, large complex institutions and those that have external reporting requirements may have perceived the need to develop a management information capability to support decision making earlier. That is, the complexity and size of the schools and the demand for accountability reporting on a periodic or on-demand basis required administrators to have access to a wide range of information which traditional methods could not adequately support. Second, the larger institutions and those with multiple campuses likely had existing staff expertise in the areas of data processing and quantitative analysis to support the development of a CBMIS.

It is interesting to note that although multicampus institutions perceived the need for CBMIS and began preparing for its implementation earlier, single-campus schools appear to have made more progress in terms of actual implementation. The data imply that complex governance structures, lack

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[6] Ibid.

of information commonality, and coordination problems familiar to those in multicampus environments have tended to slow the implementation of CBMIS in the multicampus institutions.

The large increase in CBMIS development within the last three years may be the result of several factors. The severe financial constraints higher education is facing and the increasing demands for accountability reporting became realities in the late 1960s and may have forced many institutions to turn to more sophisticated managerial techniques to allocate and report on the use of their increasingly scarce resources. In addition, by 1970 data processing technology had arrived at the point where complex data bases and generalized retrieval systems could be developed with a reasonable expectation of success. Finally, the development of new analytical tools, such as simulation models which require considerable data to support their use, and, even more importantly, of common data element definitions through which comparable data bases could be developed, began to bear fruit by 1970 and likely contributed to the development of CBMIS at many institutions.

To What Extent Are Various Types of Information Included in CBMIS?

The survey sought to determine the extent to which major information areas (student, financial, staff, and physical facilities) are being incorporated into the CBMIS. Student information appears to be the most advanced, followed by financial, staff, and physical facilities information.

Table 7
Status of Information Areas in CBMIS (All Institutions)

	%Not Under Consideration	%Planning	%Implementing	%Fully Implemented
Student	0	28	49	23
Financial	1	42	41	16
Staff	2	42	45	11
Physical Facilities	6	53	29	12

Private institutions appear to have progressed somewhat further in incorporating financial information into their CBMIS than have their public counterparts. A similar situation existed for student information, but physical facilities information has received greater attention from public institutions. No difference between public and private schools could be discerned in terms of their inclusion of staff information into their CBMIS.

Overall, it appears that in the two most extensively developed information areas, student and financial, private institutions are slightly ahead of public institutions in terms of including these data in their data bases. Public institutions may have more extensive information on physical facilities in their data bases because in many states governmental regulations require institutional reporting on equipment inventory, capital equipment replacement, and space planning and allocation as a basis for determining funding levels for public colleges and universities.

The indication that private institutions have proceeded more rapidly with including student and financial information into their CBMIS data bases than have their public counterparts may be due to two factors. All of the private schools reporting in the survey were single-campus institutions,

and such schools, as mentioned previously, have had greater implementation success to date. In addition, more private institutions may be facing severe financial and management problems and may feel compelled to move more rapidly with the inclusion of this kind of data into their CBMIS data base in order to use other management tools and to make more objective management decisions.

What Components of a CBMIS Are Being Used and to What Extent?

Four major components appear to constitute most CBMIS in academic institutions. These include integrated data bases, commonly defined data elements, generalized information retrieval systems, and techniques used to ensure data security.

Most respondents reported that their CBMIS data base was composed of related subfiles that conceptually form a single integrated file. Few institutions indicated that they use either a single physically integrated file or separate unintegrated files for their CBMIS data base.

Most CBMIS institutions reported that they were using at least some commonly defined data elements. Less than 4 percent of the responding CBMIS institutions indicated that they had no commonly defined data elements. Interestingly, institutions in the 3,000-6,000 enrollment range reported the greatest frequency of all data elements commonly defined, which may be due to either the ease of achieving such commonality in a small institution or the relative newness of the institution to administrative computing, enabling it to begin with commonly defined data elements.

A majority of the responding CBMIS institutions reported planning a generalized information retrieval system for their CBMIS. A somewhat smaller group indicated that such a system was already in operation, while very few respondents indicated that they were not considering such a system. Large institutions, with over 15,000 students, showed a significantly greater frequency of systems already in operation. A majority of the institutions reported that their information retrieval systems run both on-line and batch requests and can handle scheduled as well as unanticipated reports. Most information retrieval systems also require the assistance of a professional programmer and do not have the capability to retrieve historical or diverse information as easily as current operating information from within a single information area.

Almost all of the responding CBMIS institutions indicated that administrative policies and data processing procedures exist to ensure data security within the CBMIS data base. A majority of schools also indicated that software security features were part of their CBMIS.

Of the 296 institutions reporting CBMIS activity, nearly half indicated that all four components (integrated data base, commonly defined data elements, generalized information retrieval system, and data security techniques) were included in their CBMIS. An integrated data base and commonly defined data elements were mentioned most frequently by respondents as being included in the CBMIS.

Table 8
Combination Responses CBMIS Components

N	%	Integrated Data Base	Common Data Elements	Information Retrieval System	Data Security (Software/Hardware)
140	47	X	X	X	X
87	29	X	X	X	
18	6	X	X		X
18	6	X	X		
263	88				

In summary, the most critical components of a CBMIS appear to be the integrated data base and commonly defined data elements. In fact, without these two components there could be no CBMIS. The creation of an integrated data base with commonly defined data elements is also the most expensive portion of CBMIS development in terms of time, effort, and cost. Once a commonly defined and integrated data base is established, the development of a retrieval capability and of security techniques becomes a comparatively simple matter. The indication that nearly half of the responding institutions reported all four components in operation, and less then 5 percent reported not having either an integrated data base or commonly defined data elements, supports the contention that most of the institutions engaged in what they call CBMIS development are truly developing a CBMIS capability and are not simply giving their operational data processing systems this generic title.

IV. ORGANIZATIONAL CONSIDERATIONS

Who Has Responsibility for CBMIS?

Each institution was asked to identify, by title, the administrator with overall responsibility for the CBMIS project. The most frequently mentioned administrator was the director of Data Processing, followed by the director of Institutional Research/Planning and the vice-president or director of Finance or Business Affairs. Of the responding institutions, 40 percent indicated that the chief administrator for the CBMIS reports directly to the president, while another 34 percent indicated that he reports to the chief financial, business, or planning officer of the school.

Responsibility for the design of CBMIS was assigned to the Data Processing department according to 53 percent of the respondents. Of the respondents, 23 percent indicated that CBMIS design was the responsibility of the Office of Institutional Research/Planning, while 12 percent of the schools reported that this was the responsibility of a specially created task force or committee. In terms of implementation responsibility, Data Processing was mentioned most frequently (63%), followed by Institutional Research/Planning (19%) and special committees (10%). It appears that Data Processing has a predominant role in both CBMIS design and implementation.

In terms of top-level administration support, the vice-president for Administration, Planning, or Finance was the individual cited most frequently as the primary initiator of the CBMIS project. He was followed in importance by the president, the director of Data Processing, and the director of Institutional Research.

To What Extent Do Institutional Constituencies Contribute to the Development of CBMIS and to What Extent Are They Served by CBMIS?

The survey also sought to determine the importance of the contribution to the CBMIS planning effort of several institutional constituencies: general administrative officers such as presidents and vice-presidents; administrative support officers such as the registrar or director of business affairs; academic administrators such as deans and department heads; faculty members, either individually or through committees or senates; and students, either individually or through committees or student government.

Administrative support officers appear to play the most prominent role in the planning of an institution's CBMIS. Following closely in importance are the top-level general administrators such as vice-presidents, presidents, and provosts. The finding was somewhat surprising, considering the fact that the MIS literature emphasizes how the MIS must be designed for use by top management for strategic planning.

What is important, however, is that, in most cases, registrars, business officers, and personnel officers are making significant contributions to CBMIS development. These are the same people who were also involved in the development of operational data processing systems. A question to be raised is, Will CBMIS be any different from those earlier administrative data processing efforts? One must conclude that they will be based on the reported important contribution of top-level general administrative officers to the CBMIS effort. It is these top-level administrators and their staff who require the great flexibility, rapid response, information integration, and analytical capability that CBMIS promises. The fact that support

administrators are so active in CBMIS development may be accounted for also by the fact that CBMIS often is built on operational data processing applications and that frequently CBMIS development requires major redesign of these applications. Also, much justification for creating a CBMIS capability is found in the fact that many operational administrative data processing systems must be redesigned to meet changing requirements or to capitalize on new computer technology.

Table 9
Contributions to CBMIS Planning and
Service Received from CBMIS--Rankings

	Contribution to CBMIS		Service from CBMIS	
General Administrative Officers	2	*(1230)	2	(1502)
Administrative Support Officers	1	(1347)	1	(1546)
Academic Administrators	3	(890)	3	(1289)
Faculty	4	(362)	4	(556)
Students	5	(178)	5	(397)

*(Weighted Score)

While academic administrators often are required to feed information to the CBMIS when it is in operation, they appear to have a relatively minor involvement in its planning. The survey indicated academic administrators as being primary to CBMIS planning at only nineteen institutions. Faculty and students, on the other hand, received little or no ranking as important contributors to CBMIS planning.

In terms of service received from CBMIS, it was found that the design priorities built into the CBMIS reflected the extent of each constituency's

contribution to the planning of the CBMIS. Thus, administrative support officers, followed by general administrative officers, academic administration, faculty, and students, comprised the priority ranking for CBMIS service. This was the same as the ranked importance of each group's contribution to the planning of the CBMIS. Thus, the picture of CBMIS in academic institutions today appears to be one of a system designed for and by administrators for their exclusive use.

To What Extent Are Institutions Providing Additional Funds for CBMIS Development?

Slightly more than half of the responding institutions indicated that no additional funds were being allocated for CBMIS. Multicampus system offices, however, reported a significantly higher frequency of new funding for CBMIS than was the case for other respondents. It also was noted that institutions with large enrollments (over 15,000) were more likely to create new budgets for CBMIS than were smaller schools, suggesting that the smaller the institution, the less likely it is to provide additional funds for CBMIS.

The fact that many multicampus system offices have been assigned the responsibility of developing a CBMIS to assure information commonality across its member institutions may be in part responsible for this difference. In addition, many system offices have been established relatively recently and the creation of a new budget for CBMIS activity may reflect this fact. Finally, system offices are less likely to have had previous direct responsibility for operational administrative data processing systems than are the other two types of campuses. Top administrators at single-campus and campus-within-a-system institutions may feel that this new phase of administrative computing should be carried on by these same Data Processing departments within their existing budgets.

How Does CBMIS Evolve?

The survey assessed several factors that may contribute to the development of CBMIS.

Survey responses suggest that the longer an institution has been using a computer for administrative purposes, the more likely it is that the school is planning or operating a CBMIS. However, there was little relationship between the length of time an institution has been engaged in administrative computing and the length of time it has been planning or operating a CBMIS. Also, the development of CBMIS appears to be independent of whether the host computer is dedicated to administrative work or is a shared administrative/instructional machine.

It was observed also that for each information area, such as student information, the greater the extent of computer use to maintain and process this information, the more advanced it appeared in terms of CBMIS development.

It is not clear, however, whether computerization of administrative information areas has facilitated, impeded, or is, in fact, a by-product of CBMIS development. Although the data indicated a strong relationship, one can only speculate as to the causality involved from the available data. For example, it is likely that larger institutions and those with a lengthy administrative data processing history have gained an advantage from having had computerized administrative information for operational and control applications. On the other hand, many of these administrative applications were likely developed on a piecemeal basis, having little relationship to each other, and were developed under an earlier computer

technology. Thus, it is possible that such institutions, although benefiting from the experience of developing early administrative data processing applications, have been forced to redesign, at great expense in time and money, these administrative systems in order to support a CBMIS. Smaller institutions and those with more recent data processing experience, while having little administrative data processing background, may have been able to develop their operational and CBMIS applications concurrently. It is likely that all these factors in combination are responsible for the relationship between the extent to which the computer is used to maintain and process administrative information of various kinds and the extent which this information has been included in the CBMIS.

Another significant factor was the media (punched cards, magnetic tape, direct access devices, and teleprocessing) primarily used in the computer processing of each information area. Information areas processed on direct access devices, such as disks or drums, tended to show the greatest extent of implementation in CBMIS. Magnetic tape was second and punched cards third. Teleprocessing, because of the few institutions using this advanced medium, was ranked lowest. However, teleprocessing ranked first or second, depending on the information area, in percentage of responses that appeared in the "in implementation" or "fully implemented" categories of CBMIS development. Thus, the more advanced the media (on a continuum from punched card, the least advanced, to teleprocessing, the most advanced), the greater the likelihood that the information area was in the process of being implemented or was completely implemented in CBMIS.

Finally, slightly less than half of the responding institutions indicated that they engaged in a formal study of information requirements prior to

beginning CBMIS development. However, smaller institutions (under 6,000) showed a greater tendency to engage in such formal studies than did larger schools.

What Impact Has CBMIS Had on the Organizational and Decision-Making Practices of Colleges and Universities?

The use of CBMIS in nearly half the institutions reporting tends to be accompanied by some increase in the centralization of administrative decision making. A large majority of respondents also indicated that since the use of CBMIS began decisions that reflect objective management considerations have increased in comparison to those that reflect political considerations.

Table 10
CBMIS Impact on Decision Making (All Institutions)

	% Increased	% Unchanged	% Decreased
Centralized Decision Making by Administration	41	51	8
Managerial vs Political Decisions	70	29	1
Faculty Role in Decision Making	24	75	1
Student Role in Decision Making	13	86	1

Organizationally, it appears that the introduction of CBMIS has had little effect on the number of levels in the administrative hierarchy, has resulted in increases in the size of data processing and institutional research/

planning staffs, has not affected administrative support staffing (Businesss Office, Registrar, and so forth) at most institutions, and has resulted in overall administrative staff increases and increases in the number of administrators with quantitative or computer background. The result of this latter trend may be the development of a specialized class of middle managers and technicians within the university. Systems analysts, computer experts, accountants, and quantitatively oriented administrators are likely to become more and more responsible for the institution's administration and management.

Table 11
CBMIS Impact on Organization (All Institutions)

	% Increased	% Unchanged	% Decreased
Number of Administrative Levels	7	85	8
Size of I.R. or Planning Staff	34	62	4
Size of ADP or MIS Staff	52	44	4
Size of Support Staff	8	76	16
Size of Administrative Staff	20	66	14
Number of Administrators with Quantitative or Computer Background	47	52	1

It is difficult to predict the direction university governance will take if the trend to provide CBMIS support primarily to the central administration continues. One might speculate, for example, that administrative control over the CBMIS will place the administration in a rather advantageous position in relation to the faculty and students and may result in even greater administrative influence in the institutional decision-making processes.

The possibility that information contained in the CBMIS data base will be widely shared by the administration with faculty and students, or that faculty and students will have free access to it, is unlikely. Increasing public and governmental concern over invasion of privacy, security of information, and computer-based fraud is likely to result in the administration maintaining even tighter control over the CBMIS data than may be the case presently.

V. SUMMARY

Historically the use of computers for administrative applications in colleges and universities has involved the automation of clerical tasks in the area of student records, payroll, and other financial records. Usually there has been little effort to coordinate the development of diverse applications at the institutional level. Also, these administrative uses have generally lagged behind in similar developments in industry. In recent years many internal and external pressures for improved management information have stepped up the pace of development and implementation of computer-based operational and management information systems in higher education. The 1974 NCHEMS Survey of administrative computing and the more extensive CBMIS Survey provide information to identify some definite trends in this area. The following statements summarize some of the major trends identified.

Installation Use

A majority (80%) of the institutions responding to the NCHEMS Survey process both administrative and scientific applications in a "combined installation." There is a general trend to establish the computer installation as a "utility" serving all of the needs of the institution.

Processing Mode

Institutions report that they are planning for more and more applications to be developed for on-line interactive processing. Many institutions, however, are still processing administrative data with "tabulating" techniques on third-generation computer equipment.

Application Development

Data base management systems technology is viewed as a potentially valuable tool to reduce development and redevelopment costs of administrative information systems and to encourage an integrated approach to the application development process.

Hardware/Personnel Expenditures

Expenditures for administrative computing average approximately 50 percent for personnel and 50 percent for hardware and operational expenses. Discussions with a number of directors of administrative data processing operations indicate that this distribution does not seem to have changed greatly in the last decade.

Computerized Applications

Student and financial records are the areas with the largest allocation of administrative computer resources, and physical plant administration is reported to be the least computerized.

Major Problem Areas

The major problem areas reported most often were "key application areas not developed" and "lack of user involvement and capability in systems design." The problems rated as being of least concern were "support of top-level management" and "organizational problems." These problem areas were rated by presidents, vice-presidents, and data processing managers.

Why Management Information Systems?

The most important reason for moving to computer-based management information systems seems to be the improvement of internal management with the support of other management tools being the second most important reason cited.

Institutional Complexity and Development Progress

Large and multicampus institutions generally started computer-based management information systems implementation earlier, but single-campus institutions appear to have made more progress with actual implementation.

Key Elements for CBMIS

The key elements in the successful development and implementation of computer-based management information systems identified most often are tne integrated data base and commonly defined data elements.

Organization and Staffing

Organizationally, leadership for computer-based management information systems appears to be coming from the administrative vice-president level with most Data Processing departments responsible for the system design. There also appears to be an increase in the number of computer- and quantitatively oriented administrators, as well as an increase in the size of technical support staff in the area of institutional research and data processing.

After viewing the results of the 1974 NCHEMS Survey and the CBMIS Survey, it is clear to the authors that more detailed information

concerning the use of computers for administrative operations in higher education is in order. This publication should serve to call attention to some of the major trends in this field and hopefully will provide some baseline information for further investigation.

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